ACCESSION #: 9910140021

NON-PUBLIC?: N

LICENSEE EVENT REPORT (LER)

FACILITY NAME: Indian Point No. 2 PAGE: 1 OF 10

DOCKET NUMBER: 05000247

TITLE: Reactor Trip, ESF Actuation, Entry into TS 3.0.1, and

Notification of Unusual Event.

EVENT DATE: 8/31/1999 LER #: 1999-15-0 REPORT DATE: 9/30/1999

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: N POWER LEVEL: 99

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:

50.73(a)(2)(i)

50.73(a)(2)(ii)

50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:

NAME: John Beck, Senior Licensing Engineer TELEPHONE: (914) 734-5692

COMPONENT FAILURE DESCRIPTION:

CAUSE: SYSTEM: COMPONENT: MANUFACTURER:

REPORTABLE EPIX:

SUPPLEMENTAL REPORT EXPECTED: YES

EXPECTED SUBMISSION DATE: 12/20/1999

ABSTRACT:

On August 31, 1999 the Instrument and Control (I&C) group was replacing a defective bi-stable PC-457A, the pressurizer low pressure trip bi-stable for Protection Channel 3. To support this maintenance, the Over Temperature Delta Temperature (OTDT) channel trip for Protection Channel 3 was placed in the trip position. A spurious electrical spike occurred on the OTDT Protection Channel 4. This made up the "two out of four" reactor trip logic causing an OTDT reactor trip. After the reactor tripped, a sustained undervoltage condition on 480 VAC bus 5A or 6A caused the station blackout logic matrix to generate a blackout signal, stripping the 480 VAC buses and reloading them onto the emergency diesel generators (EDG). Bus 6A loaded onto its EDG and then tripped off due to an over-current trip on the EDG output breaker. Battery Charger 24 is powered from bus 6A. The battery supported the DC loads for approximately 7.4 hours. During that period of time, power was not restored to Battery Charger 24. Subsequently Instrument Bus 24 was lost when the voltage on DC bus 24 became too low for Inverter 24 to provide AC power to the instrument bus. As a result, a Notification

of Unusual Event (NUE) was declared based on Emergency Action Level (EAL) 7.3.1 due to an unplanned loss of approximately 75% safety system annunciators for greater than 15 minutes. The NUE was exited at 03:30 hours on September 1, 1999 when power was restored.

PLANT AND SYSTEM IDENTIFICATION:

Westinghouse 4-Loop Pressurized Water Reactor

IDENTIFICATION OF OCCURRENCE:

Reactor Trip, ESF actuation, subsequent Loss of 480 Volt Bus 6A, and entry into a Notification of Unusual Event (EAL 7.3.1).

EVENT DATE:

August 31, 1999

REPORT DUE DATE:

September 30, 1999

REFERENCES:

Condition Reporting System (CRS) Numbers 199906545, 199906643, and 199906868.

PAST SIMILAR OCCURRENCE:

LER Numbers 91-01 and LER 91-10

DESCRIPTION OF OCCURRENCE:

On August 31, 1999 the Instrument and Control (I&C) group was replacing a defective bistable, PC-457A, the pressurizer low pressure trip bistable for Protection Channel 3. To support this maintenance, the Over Temperature Delta Temperature (OTDT) channel trip for Protection Channel 3 was placed in the trip position. At approximately 14:31 hours, a spurious electrical spike occurred on the OTDT Protection Channel 4. This made up the "two out of four" reactor trip logic to cause an OTDT reactor trip.

After the reactor tripped, a sustained undervoltage condition on 480 VAC bus 5A or 6A caused the station blackout logic matrix to generate a blackout signal, stripping the 480 VAC buses and reloading them onto the emergency diesel generators (EDG). Bus 6A loaded onto its EDG and then

tripped off due to an over-current trip on the EDG output breaker. Battery Charger 24 is powered from bus 6A. The battery supported the DC loads for approximately 7.4 hours. During that period of time, power was not restored to Battery Charger 24. Subsequently Instrument Bus 24 was lost when the voltage on DC bus 24 became too low for Inverter 24 to provide AC power to the instrument bus. As a result, a Notification of Unusual Event (NUE) was declared based on Emergency Action Level (EAL) 7.3.1 due to an unplanned loss of approximately 75% safety system annunciators for greater than 15 minutes. The NUE was exited at approximately 03:30 hours on September 1, 1999 when power was restored.

ANALYSIS OF OCCURRENCE:

These events are reportable under: 10 CFR 50.73(a)(2)(iv) for any event or condition that that resulted in manual or automatic actuation of any engineered safety feature (ESF), including the reactor protection system (RPS); 10 CFR 50.73(a)(2)(i)(A) for the completion of a Technical

Specification required shutdown; 10 CFR 50.73(a)(2)(i)(B) for any operation prohibited by Technical Specification; and 10 CFR 50.73(a)(2)(ii)(C) for being in a condition not covered by plant normal and emergency operating procedures.

There was no release of radioactive materials, and sufficient safeguards equipment remained available to respond to design basis events. The Conditional Core Damage Probability for the event is calculated to be approximately 2E-4. While Bus 6A is a safety significant component, plant conditions at the time of the loss of the bus would have permitted additional power recovery actions had the availability of AC power or core cooling equipment further degraded. The potential for implementing these additional recovery actions has the effect of further ameliorating the overall risk associated with loss of the bus. Therefore, the health and safety of the public were not adversely affected by this event.

ANALYSIS OF OCCURRENCE (Continued):

The root cause analysis is ongoing and consequently determination of the root cause(s) and corrective actions and implementation of corrective actions for this matter have not been completed. This report will be supplemented when determination of root causes is completed and corrective actions are identified.

CAUSE OF OCCURRENCE:

Preliminary results of the investigations are provided below.

Cause of trip signal

On August 30, 1999 Instrument and Control (I&C) technicians were performing test PT-Q-55, Pressurizer Pressure, and found bistable PC-457A, the pressurizer low pressure trip bistable for Protection Channel 3, would trip and reset at different values. The values were within the acceptance criteria but the bistable should have distinct trip and reset points. The test was stopped and the channel was restored to an operable condition.

Protection Channel 4 still needed to be tested. A decision was made to replace the bistable prior to continuing the test. On August 31, 1999 I&C technicians commenced replacing the defective bistable (PC-457A). To support this maintenance, the OTDT channel trip for Protection Channel 3 was placed in the trip position. This action placed half the trip logic for the OTDT trip. Any trip signal generated on any of the other three channels while channel 3 was in the trip state, would cause an OTDT reactor trip.

At approximately 14:31 hours, a spurious electrical spike occurred on the OTDT Protection Channel 4. This made up the "two out of four" reactor trip logic causing an OTDT reactor trip. The spurious trip signal on channel 4 lasted approximately 438 milliseconds, and was of sufficient duration to cause a reactor trip event. Investigation into this signal's noise history revealed a similar channel 4 OTDT spike occurred on August 26,1999 at approximately 17:09 hours. The duration of this signal was approximately

73 milliseconds and it was sufficient to cause an OTDT channel trip alarm in the central control room (CCR). A Condition Report (CRS #199906545) was written on the August 26, 1999 channel spike event. The system engineer evaluated this event on the morning of August 31, 1999 and intended to trend the event to determine if a problem was developing. Further, the system engineer checked the margin between the variable setpoint and the actual delta-T condition and verified it to be satisfactory.

CAUSE OF OCCURRENCE (Continued):

The OTDT trip has more input signal parameters than any other Reactor Trip. Since there are more inputs to OTDT, the probability of electromagnetic interference (noise) affecting the OTDT loop is greater as any one electrically "noisy" input will cause the entire channel to become electrically "noisy." The OTDT setpoint generator uses a second order transfer function to generate a variable setpoint for the loop for the Tave

input on each loop. The OTDT bistable compares a 0-8 VDC signal, representing loop Delta-T, to a 10-50 ma signal which represents the setpoint from the setpoint generator. The comparison of this signal to setpoint, then determines. if a trip condition exists on that channel.

A battery charge was in progress on the nominal 125 volt DC Bus 24 on August 31,1999 when the reactor trip occurred. This resulted in a higher voltage being present on the 24 DC bus than it might normally carry. Higher voltage, if a ground or partial ground condition were present, would more easily allow an intermittent ground to occur. It has already been shown that such grounds in the past have caused a high channel noise level on the other OTDT circuits, and there is evidence to support the existence of a ground on the 24 DC bus. To date, no failure has been found in the channel 4 OTDT circuit. The investigation into the cause of the channel spike continues. The investigation into the cause of the 24 DC bus ground also continues.

Undervoltage Trip of the 480 VAC buses

When the reactor tripped, the plant trip transient and operator response appeared normal for a full power plant trip condition. The main generator tripped and 345 kV Buchanan switchyard breakers 7 & 9 opened as designed, isolating the electric generator 30 seconds after the turbine trip signal.

The four inside 6.9 kV station service buses fast transferred to the external 138 kV supply power via the Station Auxiliary Transformer (STAUX). At the moment this occurred, the Safety Assessment System (SAS) computer detected a low voltage condition on all the 480 VAC buses. This implies that the feeder voltages to the 480 VAC buses from the STAUX was too low, and a low voltage condition was coming through the STAUX to the 480 VAC buses. This condition was on all buses and not just the ones getting new loads on them as post trip equipment cycled online.

This fast transfer included all loads supplied from the 480V bus and 6.9 kV buses except for 22 Condensate Pump. 22 Condensate Pump is designed to be

stripped from its bus during this transfer process. The transferred load totaled approximately 3300 amps through the Station Auxiliary Transformer. Throughout this event the Station Auxiliary Transformer Tap Changer remained in manual mode due to a defective voltage control relay.

CAUSE OF OCCURRENCE (Continued):

On a transfer of load to the offsite bus, the 480 volt bus voltage could reduce to values lower than the degraded voltage setpoint. This voltage level would activate the degraded voltage relays which are set to trip at 421 V 6V in 180 sec 30 sec. However, during this interval, the tap changer if operating in automatic is designed to automatically move to restore the voltage within 1 minute of the event.

With the tap changer not in automatic mode, manual intervention would have been required to control the voltage on the 480V buses to recover from a transient. During this event there was no manual intervention, therefore

normal voltage was not restored before the undervoltage relay settings (voltage level and duration) were satisfied. The time between the trip of the main generator/fast breaker transfer evolution and the blackout signal stripping the 480 VAC buses was 181 seconds. This validates the indication that a low voltage condition was present on the 480 VAC buses. This caused the undervoltage trip.

Loss of bus 6A

At approximately 14:35 hours a start signal went to the Emergency Diesel Generators (EDG) coincident with a loss of the 480 VAC buses due to a station blackout signal. The station black out signal is generated by a loss of either 480 VAC bus 5A or 6A.

23EDG is the emergency power supply to 480 VAC bus 6A. Eight seconds after starting the EDG, the output breaker from the EDG to bus 6A closed, at approximately 14:35 hours. The breaker then tripped approximately fourteen seconds later. The Amptector flag for the 23EDG output breaker indicated

it tripped open on short term over current. When bus 6A was lost this second time, it was left de-energized due to the potential for a fault to exist on the bus. The other 480 VAC buses were picked up on their respective EDGs without incident.

Motor Driven Auxiliary Feed Water Pump 23 (MDAFWP 23) is powered from 480 VAC bus 6A and is sequenced on 12 seconds after bus energization if a demand start signal for the pump is present under these plant conditions (Unit trip, blackout, no Safety Injection).

A demand start was present due to the low steam generator levels caused by the reactor trip transient. Component Cooling Water Pump 23 (CCWP23) cycles on at 11 seconds and Service Water Pump 23 (SWP 23) cycles on at 15 seconds. Post event trip testing performed on September 2, 1999 shows that MDAFWP23 takes five seconds to cycle up to speed after receiving a start signal. The starting current surge from this pump is present for two seconds of this time period.

CAUSE OF OCCURRENCE (Continued):

Post trip testing on the EDG 23, DB-75 supply breaker to 480 VAC bus 6A found that the actual over current trip setpoint for its Amptector was at 3200 amps, rather than the 6,000 amps setting as designed. This improper setting was caused by the difficulty of setting the Amptector low in its high amp, coarse setting span and the lack of post setting tests (primary injection) that verify the setting. The combined starting current surges of any two of the aforementioned pumps is approximately 4,400 amps according to empirical data and a starting surge study performed as a result of this transient. The 3200 amp actual Amptector setting for the EDG supply breaker would trip on over current when these loads cycled on during this transient.

No damage was found on any supplied loads from this bus, indicating that all breakers, timers and motors functioned as designed.

The cause of the breaker improper setting can be categorized as two fold. First, the equipment used to set the breakers has a low range (fine) scale from 0- 1 0 amps (secondary coil setting, not primary over-current setting) and then a high range (coarse) scale for above ten amps. The setting equivalent to 6000 amps primary over-current protection is very close to this ten amp setting for the coil. Unless extreme care is used in setting this number, a slight shift in its value can result in a sizeable shift in the over current trip setting. After the event, breaker settings were checked on the other DB-75 breakers with settings near the fine/course switchover value.

The second reason for the breaker improper setting was no requirement to perform a primary injection current test and actually measure the breaker

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trip point. It was accepted that if the breaker is set correctly, it will function correctly, and no back up checks had been put in place to verify

this.

When 480 VAC bus 6A was lost the second time and not recovered this sent a logic signal to the station blackout logic that a loss of offsite power had occurred. Offsite power was present the entire time but not available without the generator lockout (86 relays) being reset. Accordingly, the blackout logic signal did not recognize this condition. The result is the blackout logic would not allow the transfer of buses 5A, 2A, and 3A back to their normal offsite power supplies. To transfer the energized buses to offsite power, the blackout logic signal must be reset. An operator option to defeat this logic could be to reset the main generator "86 relay " trip hold off devices and seal in circuits (this in effect signals the logic that no unit trip is present.). This was not done although an Abnormal Operating Instruction (AOI 27.1.1) contained guidance for restoration of the normal power source provided no bus faults existed. The operators deemed such an act imprudent as it would block out any further black out

signals which might come from a real condition, and result in the loss of all the 480 VAC buses. Although AOI 27.1.1 was not used following the event, there was no actual bus fault and a decision could have been made to utilize it had further degradation of the 480 VAC power source occurred.

CAUSE OF OCCURRENCE (Continued):

This placed the plant in the situation of having offsite power available for the plant to use, such as powering reactor coolant pumps and condensate pumps. However, offsite power was not available as it was not used as designed to power the 480 VAC buses under these conditions.

Upon loss of 480 VAC bus 6A, CCR operators entered Technical Specifications (TS) 3.0.1 as the governing Limiting Condition for Operation due to the multiple loss of safeguards loads powered from bus 6A. This required the plant to be placed in cold shutdown within 30 hours of hot shutdown. The trip placed the plant in hot shutdown, effectively requiring cold shutdown

within 30 hours from the time of trip. TS 3.3.F. Lb requires the plant to be less than 350 degrees F after 6 hours, if an essential service water header cannot be restored within 12 hours of hot shutdown in the event fewer than three essential SWPs are available. The Limiting Condition for Operation (LCO) for TS 3.3.F.1.b was not met. The operators regarded TS 3.0.1 as the more limiting (requiring cold shutdown condition versus 350 degrees F), and they acted under the TS 3.0.1 requirements.

Loss of 125 Volt DC Bus 24.

DC bus 24 is fed from two power sources. One power source is Battery Charger 24, which is fed from MCC27A. MCC27A is powered from 480VAC bus 6A. The second source of power for DC bus 24 is Battery 24. The DC bus in turn supplies primary power to Inverter 24, which then supplies 118VAC power to Instrument Bus 24. The alternate power supply for Instrument Bus 24 in the event of a failure of Inverter 24, is a transformer which is also powered from MCC 27A. Therefore, Battery Charger 24 and the alternate AC

supply to Instrument Bus 24 where both deenergized with bus 6A.

Battery 24 is composed of 58 standard lead-calcium wet cells and sized to carry its designed shutdown load for a period of two hours following a plant trip and a loss of all AC power. At approximately 21:53 hours on August 31, 1999, Instrument Bus 24 was lost due to the voltage on DC bus 24 being too low for Inverter 24 to provide AC power to the instrument bus. Once the inverter lost power, and since the alternate source of power was MCC27A, Instrument Bus 24 lost power. This resulted in the loss of the alarm and indication functions powered by this instrument bus.

The 24 battery supported the DC (and instrument bus 24) loads for approximately 7.4 hours. During that period of time, power was not restored to Battery Charger 24 or MCC27A.

CAUSE OF OCCURRENCE (Continued):

Notification of Unusual Event

A Notification of Unusual Event (NUE) was declared at approximately 21:55 hours based on Emergency Action Level (EAL) 7.3.1, due to an unplanned loss of most (approximately 75%) safety system annunciators for greater than 15 minutes.

At approximately 00:43 hours on September 1, 1999, 480 VAC bus 6A was restored and powered from EDG 23. At approximately 00:50 hours MCC 27A was energized and powered Instrument Bus 24. 480 VAC Buses 5A, 2A and 3A were subsequently restored to their normal offsite power supplies between 02:00 and 03:00 hours on September 1, 1999 and at approximately 03:30 hours the NUE was exited upon the restoration of affected CCR annunciators.

During an engineering review of this event it was subsequently determined that the plant met the conditions for entry into EAL 6.1.1 for unavailability of off-site power at approximately 14:46 hours on August 31, 1999. This was due to the undervoltage condition on bus 6A complicating the transfer of the other 480 VAC buses back to the available off-site

power. This discovery was reported in a follow-up notification made to the Emergency Notification System (ENS) when discovered on September 13, 1999 at approximately 06:05 hours.

CORRECTIVE ACTIONS:

Immediate corrective actions taken.

o All applicable steps in Emergency Operating Procedures E-0 and ES-01 were performed

o Plant was stabilized after the trip with the 480 buses 5A, 2A and 3A on the Emergency Diesel Generators (EDGs).

o Steam Driven Auxiliary Feedwater Pump 22 (22 SDAFWP) was manually brought online to feed 23 and 24 Steam Generators (SGs) after the loss of Motor Driven Auxiliary Feedwater Pump 23 (23 MDAFWP) caused by loss of bus 6A.

o Energized 480 VAC bus 6A on September 1, 1999 at approximately 00:43 hours.

o Restored affected annunciators, and exited the NUE on September 1, 1999 at approximately 03:30 hours.

o The following conditions have been entered into the corrective action system for evaluation:

1. OTDT Reactor trip, 480VAC Bus 6A undervoltage, and 23 EDG breaker trip

2. 24 Battery discharge

CORRECTIVE ACTIONS (Continued):

3. Inappropriate TS entry

4. Timeliness of NUE Declaration

5. Management Oversight and Command and Control.

o A post trip investigative team was assembled to communicate facts, develop conclusions (root causes), and determine corrective actions to prevent recurrence.

o A Utility Assistance Team (UAT) was formed on September 1, 1999 to review the circumstances surrounding the reactor trip and subsequent Notification of Unusual Event that occurred on August 31, 1999.

o A formal Recovery Organization was identified and a recovery plan was developed to provide structure and guidance to address issues associated with the event.

The purpose of the UAT review was to independently assess the performance of plant equipment and personnel, and to report to Con Edison management the UAT's observations and recommendations.

The UAT conducted interviews with Con Edison personnel associated with the trip and near term follow-up actions. Additional UAT activities included documentation reviews and field inspections, concentrating its assessment in the areas of: event precursors, management oversight, command and control, leadership, communications, and process issues including emergency plan implementation. The UAT focused on the period immediately preceding

the trip and the 12 to 18 hours after the trip. A report was issued by the UAT on September 7, 1999 to the Plant Manager.

Follow-up Corrective Actions:

A Recovery Plan and recovery organization has been put in place to address the challenges in management, human performance, processes, and equipment that require follow-up assessments and improvement actions. Consequently, a supplemental report will be transmitted when root cause analyses and corrective actions to preclude recurrence have been finalized.

ATTACHMENT 1 TO 9910140021 PAGE 1 OF 1 HATTACHMENT 1 TO 9910140021 PAGE 1 OF 1

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September 30, 1999

Re: Indian Point Unit No. 2

Docket No. 50-247

LER 99-15-00

Document Control Desk

US Nuclear Regulatory Commission

Mail Station PI-137

Washington, DC 20555

The attached Licensee Event Report 99-15-00 is hereby submitted in

accordance with the requirements of 10 CFR 50.73.

Very truly yours,

Attachment

C: Mr. Hubert J. Miller

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